

AGALINIS (SCROPHULARIACEAE) IN THE OZARK HIGHLANDS

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ABSTRACT

The ten species of *Agalinis* known to occur in the Ozark Highlands are treated floristically. A key to the species is presented along with descriptions, flowering time, ecological data, and distribution maps. In addition, taxa considered rare are noted and their current statuses indicated.

RESUMEN

Se trataron las diez especies de *Agalinis* conocidas de los "Ozark Highlands." Se presenta una clave de las especies, con descripciones, datos fenológicos y ecológicos, y mapas de distribución. Además, se anota el estado actual de las especies raras.

INTRODUCTION

Agalinis is a New World genus of about 60 species (Canne-Hilliker 1988). Thirty-three species of *Agalinis* occur in North America (Canne-Hilliker & Dubrule 1993; Canne-Hilliker & Kampny 1991). The genus is most diversified from southeastern Texas eastward to the Florida panhandle (Canne-Hilliker & Dubrule 1993; Clewell 1985; Correll & Johnston 1970; McRoberts 1989; Vincent 1982; Wilhelm 1984). Eleven species of *Agalinis* (sensu Canne-Hilliker & Kampny 1991) occur in the Midwest (Deam 1940; Holmgren 1986; Mohlenbrock 1986; Smith 1988; Steyermark 1963; Swink & Wilhelm 1994; Voss 1996; Williams 1973), ten of which occur in the Ozark Highlands. Taxonomically, North American species of *Agalinis* are relatively well known, although the need still exists for a modern, monographic treatment of the genus. Pennell's work on the group (1929, 1935), while comprehensive and still useful, is also outdated, as recent scholarship has suggested. Studies by Canne-Hilliker and associates on the cytology, micromorphology, comparative anatomy, and seedling morphology of most species of North American *Agalinis* (Canne 1979, 1981, 1983, 1984; Canne-Hilliker 1987; Canne-Hilliker & Kampny 1991; Stewart & Canne-Hilliker 1998) have resulted in a revision of Pennell's ideas concerning the delimitations of species and the classification of and within the genus.

These revisions, along with nearly 90 years of collecting since Pennell first undertook his study of the genus, necessitate the presentation of new

data concerning the taxonomic status and distribution of *Agalinis* throughout North America. The purpose of my paper is to present an up-to-date account of the distribution, taxonomy, nomenclature, and rarity of *Agalinis* in the Ozark Highlands as well as to provide an unambiguous key for the identification of these species. Approximately 3,000 herbarium specimens from 24 herbaria were examined (listed in acknowledgments), and I made over 200 collections of *Agalinis* during the course of this study. Each dot on a distribution map represents one or more verified voucher specimens. Vouchers I collected were deposited at MO or remain in my possession.

STUDY AREA

The Ozark Highlands, often referred to as the Ozark Plateau(s), Ozark Province, the Ozark Highland (Cozzens 1940; Fenneman 1938; Sauer 1920; Thom and Wilson 1980), or locally as simply the "Ozarks," is a distinct geological area classified as the Ozark Plateaus geomorphic province (Thornbury 1965), an area of over 134,000 square kilometers. Within this geomorphic province fall two distinct ecological sections, the Ozark Highlands Section, and the Boston Mountains Section (McNab and Evers 1994). The Ozark Highlands Section comprises over 85 percent of the area, and dolomites and limestones predominate, forming one of the most extensive karst regions in the country (Nigh et al. 1992). Such extensive karst features as caves, springs, seeps, and sinkholes are common. In the Boston Mountains Section to the southwest, on the other hand, sandstones and shales predominate, and the sandstone exposures that dominate the landscape in this section stand in contrast to the more carbonate landscape of the Ozark Highlands Section.

The Ozark Highlands Section is characterized by gently rolling to heavily dissected hills, whereas the Boston Mountains Section is characterized by low mountains, open hills, and hilly plains. The varied topography, as well as the distinct bedrock and soil types displayed throughout the Ozark Highlands, has produced a unique assemblage of terrestrial and aquatic communities, and the Ozark Highlands is considered a center of endemism (Nigh et al. 1992). Broadleaf deciduous forest (mostly oak-hickory) comprises the dominant vegetation type in the Ozark Highlands, but pine forests, prairies, glades, fens, marshes, and large rivers are also present in the area and add to its biological diversity.

The climate of the Ozark Highlands is continental, with precipitation averaging 122 to 132 centimeters annually, and the annual temperature averaging 13 to 18 degrees Celsius (McNab and Evers 1994). Elevation ranges from a low of 91 meters in Missouri to 914 meters in the Boston Mountains of Arkansas (Keys et al. 1995). Portions of Arkansas, Illinois, Kansas,

Missouri, and Oklahoma fall within the boundaries of the Ozark Highlands, but the overwhelming majority of this geomorphic province is found in Missouri and Arkansas.

TAXONOMIC TREATMENT

Agalinis Raf. (nom. conserv.), New Fl. N. Amer. 2:61. 1837. *Gerardia* L., Sp. Pl. 610. 1753.

Ours annual, hemi-parasitic herbs with erect stems; leaves opposite or subopposite, linear to lanceolate or lance-ovate, sessile, entire, or (in two species) the leaves sometimes 3-cleft, laciniate, or with lateral lobes; inflorescences terminating most branches, a raceme or spike, sometimes racemiform; calyx gamosepalous, campanulate to hemispherical, 5-lobed, the lobes sometimes reduced to minute teeth; corolla gamopetalous, zygomorphic, 5-lobed, the two upper lobes reflexed-spreading or projecting forward, the three lower lobes spreading, usually pale pink to light purple, rarely white, the throat often dotted purple and with two yellow, longitudinal lines; stamens 4, didynamous; fruit a loculicidal capsule, globose, subglobose, ovoid, obovoid, or ellipsoid; seeds small, angular, the testa conspicuously reticulate, yellowish to black.

North American species are taxonomically difficult at the macromorphological level, and there is a relatively high percentage of misidentifications, especially in herbaria where specimens have not been examined critically. This frequent misidentification is a source of concern, considering the fact that 25 of the 33 North American species of *Agalinis* are tracked by state natural heritage programs as sensitive or rare species (Unpublished data, State Natural Heritage Programs, 1996 and 1997). The status of each species of *Agalinis* considered rare is indicated following its description. Status is based on the system of ranking rare taxa developed by the Nature Conservancy (LaRoe 1995). The Nature Conservancy's current method of ranking is summarized as follows (G=global and S=state): G1 and S1 (1-5 occurrences - critically imperiled), G2 and S2 (6-20 occurrences - imperiled), G3 and S3 (21-100 occurrences - rare), G4 and S4 (more than 101 occurrences - apparently secure), G5 and S5 (demonstratively secure), GH and SH (of historical occurrence only), GU and SU (possibly rare, but not enough documentation exists to propose a ranking), and GX and SX (apparently extinct or extirpated).

The synonymy listed under each species correlates with the nomenclature of other manuals a worker may use to identify *Agalinis* in the Ozark Highlands: Britton & Brown (1913), Fernald (1950), Gleason (1952), Gleason & Cronquist (1991), Holmgren (1986), Mohlenbrock (1986), and Steyermark (1963). Nomenclature follows Canne-Hilliker and Kampny (1991).

KEY TO SPECIES

Living plants of *Agalinis* appear quite different from their pressed and dried counterparts. It is helpful, therefore, to familiarize oneself with both fresh and dried material when working with this group. When identifying fresh or dried specimens, it is often necessary to examine specimens at 10X or greater magnification, and preferably with a dissecting microscope; sketching the corolla in the field while fresh to show the orientation of the lobes and the shape of the tube can also be helpful due to the membranous nature of the corollas, which can be easily distorted once pressed. The measurements used in the key and descriptions that follow are based on well-developed flowering and fruiting specimens, both fresh and dried. One must keep in mind that species in this genus demonstrate considerable plasticity, and that immature, depauperate, or diseased plants can make this inherent variation even more difficult to interpret; to the collector of such specimens: beware. There is also a genuine need for a thorough and detailed illustration of each species of *Agalinis*, which would greatly facilitate proper identification.

KEY TO THE SPECIES OF *AGALINIS* IN THE OZARK HIGHLANDS

1. Leaves lanceolate to lance-ovate, 5–25 mm wide, the upper leaves with two basal, lateral lobes; stem and calyx tube with retrorse-spreading hairs; calyx 10–16 mm long 2. *A. auriculata*
1. Leaves linear to lanceolate, 0.5–6(–7) mm broad, the upper leaves without basal, lateral lobes; stem and calyx tube glabrous or occasionally somewhat scabrous; calyx 3.5–8(–9) mm long.
 2. Longest pedicels 6 mm or less long, shorter to slightly longer than the calyx.
 3. Pedicels 1–3 mm long; calyx lobes 3–6 mm long, clearly longer than the calyx tube, the midveins of the lobes prominently ribbed; leaves lanceolate to linear-lanceolate, lower leaves sometimes 3-cleft or laciniate 5. *A. heterophylla*
 3. Pedicels 2–6 mm long; calyx lobes 0.5–2(–2.5) mm long, shorter than the calyx tube, the midveins of the lobes without prominent keels; leaves linear to narrowly lanceolate, the lower leaves never 3-cleft or laciniate.
 4. Calyx 5–9 mm long, long-campanulate; anthers 1.9–2.5 mm long; capsule 7–12 mm long, ellipsoid to oblong, longer than broad; leaves narrowly linear, 0.5–1.5 mm wide, erect and ascending, harshly scabrous above, the hairs heavily silicified, appearing marbled; fascicled leaves also ascending 1. *A. aspera*
 4. Calyx 3–5 mm long, hemispheric to short-campanulate; anthers 2.3–3.5 mm long; capsule 4–6 mm long, globose to subglobose, as broad or nearly as broad as long; leaves linear to linear-lanceolate, 1–4(–5) mm wide, spreading, arching, or curling, scabrous above, but not harshly so, or the hairs neither heavily silicified nor appearing marbled; fascicled leaves spreading, arching, or curling.

5. Middle 2/3 of main stem and largest branches noticeably to harshly scabrous; branches mostly ascending; axillary fascicles usually well-developed; 5 principal veins of the calyx (those leading to the lobes) as well as the lobes, scabrous3. *A. fasciculata*
5. Middle 2/3 of main stem and largest branches glabrous to sparingly scabrous, but not harshly scabrous; branches spreading to ascending, axillary fascicles weakly to well-developed; 5 principal veins of the calyx as well as the lobes usually glabrous, or occasionally the veins of a few capsules scabrous.
6. Middle 2/3 of main stem and largest branches scabrous, the pubescence obvious, but scattered on both the stem faces and angles (avoid areas immediately around the nodes); branches mostly ascending; axillary fascicles usually well-developed, but sometimes only weakly so, the fascicled leaves often approaching or equaling the subtending leaves in length3. *A. fasciculata*
6. Middle 2/3 of main stem and largest branches glabrous to subglabrous, the pubescence, when present, conspicuous on the angles (avoid areas immediately around the nodes); branches mostly spreading, but sometimes ascending, axillary fascicles absent or only weakly developed, the fascicled leaves, when present, noticeably shorter than the subtending leaves.7. *A. purpurea*
2. Longest pedicels 6–30 mm long, slightly to much longer than the calyx.
7. Calyx 5–9 mm long, long-campanulate; capsule 7–12 mm long, ellipsoid to oblong, longer than broad; pedicels erect-ascending to arched-ascending; leaves stiffly ascending, harshly scabrous above, the hairs heavily silicified, appearing marbled1. *A. aspera*
7. Calyx 3–5.5 mm long, hemispheric to campanulate; capsule 3.5–6 (–7) mm long, globose or obovoid, as broad as long; pedicels spreading to ascending; leaves spreading to ascending, subglabrous to scabrous, but if scabrous, the hairs neither heavily silicified nor appearing marbled.
8. Upper two lobes of the corolla arching or projecting forward over the stamens; corolla glabrous within across the base of the two upper lobes; many pedicels abruptly upcurved distally; axillary fascicles often present.
9. Stem scabrous; leaves narrowly linear, 0.8–1.5 mm wide; the two upper lobes of the corolla projecting forward over the stamens, half the length of the three lower lobes, 2–3 mm long; pedicels scabrous at least basally; anthers 3–4 mm long, the two upper filaments densely villous basally and distally; seeds 0.8–1.6 mm long, the testa cells large in proportion to the total size of the seed6. *A. homalantha*
9. Stem glabrous or with a few scattered hairs on the angles; leaves linear to narrowly lanceolate, 1–5 (–6) mm wide; the two upper lobes of the corolla arched over the stamens, subequal to the three lower lobes, 4–5 mm long; pedicels glabrous; anthers 1–2.3 mm long, the upper filaments sparingly hairy throughout, but not densely villous basally and distally; seeds 0.7–1 mm long, the testa cells small in proportion to the total size of the seed9. *A. tenuifolia*

8. Upper two lobes of the corolla reflexed-spreading; corolla pubescent within across the base of the two upper lobes; pedicels not abruptly upcurved distally (occasionally a few pedicels of *A. gattingeri* are upcurved distally); fascicles absent.
10. Outside of the three lower corolla lobes pubescent; leaves spreading, arching, or curling; numerous floriferous, lateral branches present, the flowers appearing solitary at the nodes, a terminal raceme rarely developed, the inflorescence more racemiform; stem subterete to 4-angled 4. *A. gattingeri*
10. Outside of the three lower corolla lobes glabrous; leaves mostly erect and ascending; few to many branches bearing obvious terminal racemes present; stem noticeably 4-angled and appearing winged.
11. Stem scabrous on the angles; few to many strongly ascending branches present; calyx hemispherical, the longest lobes 0.7–1.2 mm long; fruit globose 8. *A. skinneriana*
11. Stem glabrous on the angles; a few to many widely spreading branches present; calyx campanulate, the longest lobes 1.5–2.2 mm long; fruit obovoid 10. *A. viridis*

1. *Agalinis aspera* (Douglas ex Benth.) Britton. *Gerardia aspera* Douglas ex Benth.

Stem 2–7 dm, subglabrous to sparingly scabrous, the branches ascending. *Leaves* narrowly linear, stiffly ascending, 0.5–1.5 mm wide, 1.5–4 cm long, harshly scabrous above, presenting a marbled appearance, and frequently scabrous on the midveins below. *Fascicles* well-developed and also ascending. *Inflorescences* short to elongate racemes. *Pedicels* erect to arched-ascending, stout, 5–11 mm long, to 16 mm in fruit. *Calyx* campanulate, 5–9 mm long, the lobes 1.0–2.5 mm long. *Corolla* deep pink, 16–25(–28) mm long, the throat glabrous within or with a few scattered hairs across the base of the two reflexed-spreading, upper lobes. *Anthers* 1.9–2.5 mm long. *Capsule* ellipsoid to oblong, clearly longer than broad, 7–12 mm long. *Seeds* black, 0.9–1.1 mm long. $n=14$ (Löve & Löve 1982). Note: voucher not seen. *Flowering* late August–early October.

Distribution.—Dry prairies, open woodlands, glades, and bluffs. Very rare in the Ozark Highlands (Fig. 1).

Ecology and conservation status.—G5; S2 in Arkansas. Although this species has been reported from Arkansas (Smith 1988), I have not found any vouchers specimens; all specimens labeled *A. aspera* from Arkansas have proved to be another species. *Agalinis aspera* is largely a species of the eastern Great Plains, and populations found eastward of this area are mostly peripheral and of scattered occurrence, usually being restricted to xeric habitats, such as bluffs, glades, and loess hills.

2. *Agalinis auriculata* (Michx.) S.F. Blake. *Gerardia auriculata* Michx., *Otophylla auriculata* (Michx.) Small, *Tomanthera auriculata* (Michx.) Raf.

Stem 2–7(–8) dm, retrorsely scabrous, simple to sparingly branched above. *Leaves* lanceolate to lance-ovate, the upper with two basal, lateral lobes, 2.3–6 cm long, 0.5–2(–2.5) cm wide, scabrous above and below, lateral veins visible on both surfaces. *Inflorescences* spikes. *Flowers* essentially sessile, occurring in pairs in the upper leaf axils. *Calyx* campanulate, 10–16 mm long, the tube spreading-pubescent, the lobes 6–12 mm long, scabrous, longer than the tube. *Corolla* pink, 20–27(–29) mm long, the throat pubescent within across the base of the two reflexed-spreading, upper lobes. *Anthers* 1.9–2.4 mm long. *Capsule* ovoid, 9–14 mm long. *Seeds* yellowish, 1.2–1.6 mm long. $n=13$ (Kondo 1973). *Flowering* late August–September.

Distribution.—Dry or mesic prairies, fallow fields, borders of dry woods, and roadsides. Very rare in the Ozark Highlands (Fig. 2).

Ecology and conservation status.—G3; S1 in Arkansas, S2 in Illinois, S2 in Kansas, S2 in Missouri, and S1 in Oklahoma. Although a rare species throughout its range, *Agalinis auriculata* apparently can tolerate considerable disturbance, as evidenced by its ability to persist in degraded prairies, fallow fields, grazed meadows, and roadsides. Despite this apparent ability to tolerate continued human disturbance, the Jasper, Newton, Ozark, and St. Louis County, Missouri, sites, as well as the St. Clair County, Illinois, site, are based on historic collections or the populations are thought to be extirpated. Fortunately, however, there are a number of recent collections from the northern half of Missouri.

3. *Agalinis fasciculata* (Elliott) Raf. *Gerardia fasciculata* Elliott. *Gerardia fasciculata* Elliott f. *fasciculata*.

Gerardia fasciculata Elliott f. *albiflora* Palmer.

Stem 2.5–12 dm, scabridulous to harshly scabrous, much branched on larger plants, the branches ascending or spreading. *Leaves* linear to narrowly lanceolate, 1–4 cm long, 1–2(–4) mm wide, spreading, arching, or curling, scabrous above and often on the midveins below. *Fascicles* present and well-developed or sometimes only weakly so, the fascicled leaves shorter than to nearly approaching the main leaves, also spreading, arching, or curling. *Inflorescences* short to elongate racemes. *Pedicels* 2–6 mm long. *Calyx* campanulate to hemispherical, 3–5(–6) mm long, the lobes 0.5–1.5(–2) mm long, the five principal veins of the calyx (leading to the calyx lobes) scabrous; corolla pink to light purple, rarely white, 15–30 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes. *Anthers* 2.3–3.5 mm long. *Capsule* subglobose, 4.5–6(–7) mm long. *Seeds* 0.6–1 mm long, dark brown to black. $n=14$ (Canne 1981). *Flowering* from late August–late September.

Distribution.—Dry to moist prairies, borders of woods and ponds, open ground, fallow fields, and roadsides. Scattered in the Ozark Highlands (Fig.

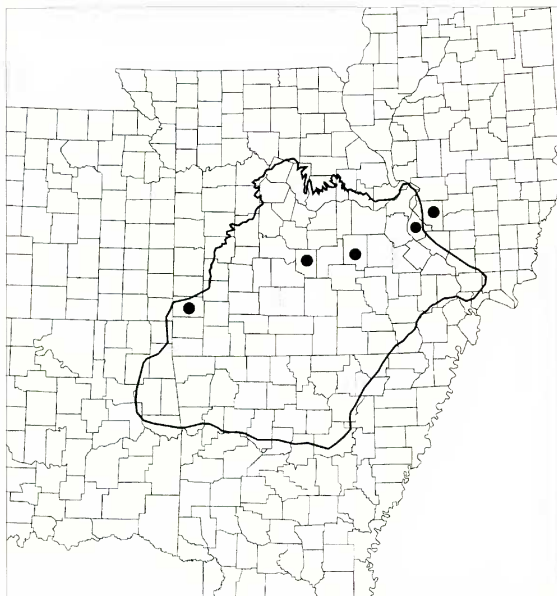


FIG. 1. Presently confirmed county records in the Ozark Highlands for *Agalinis aspera*.

3), occurring most frequently in the west and southwest portions of our area, where it nears the northern and northwesternmost limit of its range.

Ecology and conservation status.—G5; S2 in Kansas. In our area, *A. fasciculata* is most easily confused with the closely related and widespread *A. purpurea* (L.) Pennell. Less scabrous specimens of *A. fasciculata* with weakly developed fascicles are especially troublesome and difficult to separate from the more fascicled and scabrous specimens of *A. purpurea* (fortunately few specimens pose such problems). It is not the amount of stem pubescence on the less scabrous specimens of *A. fasciculata* that best distinguishes it from the more scabrous specimens of *A. purpurea*, but rather the size of the hairs, which

tend to be larger and broader-based, and in the distribution of the pubescence, which is usually scattered, but present throughout the stem faces as well as on the angles of the main stem in *A. fasciculata*.

Agalinis purpurea, on the other hand, has smooth stem faces and quite often smooth stem angles. On a noticeably pubescent plant of *A. purpurea*, the broad-based hairs occur mostly along the stem angles at regular intervals. It is important to rely on the middle two-thirds of the main stem and largest branches when making observations concerning stem pubescence, as the smaller branches on both species can be quite scabrous, especially distally. In addition, the nodes should be avoided when relying on pubescence in identification, because both species are usually quite scabrous around these areas.

4. **Agalinis gattingeri** (Small) Small ex Britton. *Gerardia gattingeri* Small.

Agalinis skinneriana (sensu Holmgren 1986).

Stem 1–5 dm, subglabrous to slightly scabrous, with spreading to somewhat ascending branches. *Leaves* narrowly linear, 0.4–1.4 mm wide, 1.5–3(–4) cm long, spreading, arching, or curling, slightly scabrous above, and often on the midveins below. *Fascicles* absent. *Inflorescence* racemiform, a true raceme rarely developed, most flowers appearing solitary at the nodes on numerous short, floriferous, lateral branches. *Pedicels* slender, spreading-ascending, 4–25(–30) mm long. *Calyx* hemispherical, 3–5 mm long, the lobes 0.5–1.4 mm long. *Corolla* pink to light purple, 8–15 mm long, the throat noticeably pubescent across the base of the two reflexed-spreading, upper lobes, the outside of the three lower lobes pubescent. *Anthers* 1.3–2.0 mm long. *Capsule* subglobose, 4–5 mm long. *Seeds* 0.5–0.9 mm long, yellowish. *n*=13 (Canne 1984). *Flowering* late August–early October.

Distribution.—Dry, open woodlands, often in rocky soils of chert or sandstone, borders of dry forests, dry roadsides, glades, bluffs, and exposed ridges. Common throughout the Ozark Highlands (Fig. 4).

Ecology and conservation status.—None. Holmgren (1986) combined *A. gattingeri* with *A. skinneriana*, but the two species have been shown to be distinct based on macromorphological and anatomical evidence (Canne-Hilliker 1987; Canne-Hilliker and Kampny 1991). *Agalinis gattingeri* and *A. tenuifolia* are the two most common species in the Ozark Highlands and are the only two species that have established themselves throughout the region with any frequency. Our other species occur mostly on the periphery of the Highlands or are localized within the area in particular habitat types.

5. **Agalinis heterophylla** (Nutt.) Small ex Britton. *Gerardia heterophylla* Nutt.

Stem 3–8 dm, glabrous to very sparingly scabrous, usually much branched

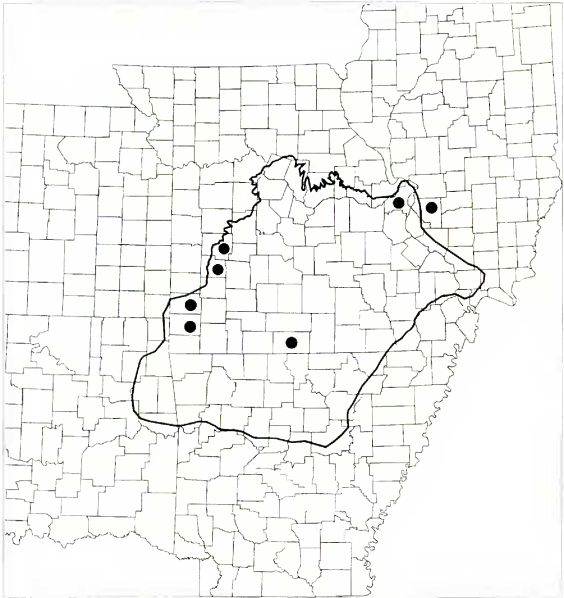


FIG. 2. Presently confirmed county records in the Ozark Highlands for *Agalinis auriculata*.

above. *Leaves* linear-lanceolate to lanceolate, 1.5–3.5 cm long, 1.8–6 mm broad, the lowermost sometimes 3-cleft or lacinate, but these usually not present at flowering time, scabrous above and occasionally on the midveins below, the undersurfaces of larger stem leaves with a few faint, but noticeable, lateral veins, (these veins usually not noticeable on dried specimens). *Fascicles* absent. *Inflorescences* short to elongate racemes. *Pedicels* stout, 1–3 mm long. *Calyx* campanulate, 5.5–10(–11) mm long, the lobes 3–6 mm long, clearly longer than the calyx tube, usually with a prominent midnerve and appearing ribbed. *Corolla* pink to light purple, 20–33 mm long, the throat glabrous across the base of the two reflexed-spreading, upper lobes.

Anthers 2.7–3.5 mm long. *Capsule* subglobose, 5–8(–9) mm long. *Seeds* dark brown to black, 0.7–1.1 mm long, $n=14$ (Canne 1981). *Flowering* late August–September.

Distribution.—Moist prairies, fallow fields, moist, open ground, and roadsides, usually in moist soils, but occasionally found in drier sites. Rare and localized in the Ozark Highlands (Fig. 5).

Ecology and conservation status.—G5; S2 in Kansas, S1 in Missouri. This is another species of *Agalinis* that nears the northwesternmost occurrence of its range in the Ozark Highlands; it is much more common in southern Arkansas, eastern Texas, Louisiana, and Oklahoma outside of the Ozarkian region of the state.

6. *Agalinis homalantha* Pennell. *Gerardia homalantha* (Pennell) Pennell.

Stem 3–10 dm, scabrous. *Leaves* narrowly linear, scabrous above and on the midveins below, 1.5–4.5 cm long, 0.8–1.5 mm wide. *Fascicles* well-developed. *Inflorescences* short racemes, with only 3–8(–10) flowers per raceme. *Pedicels* slender, spreading-ascending, often upcurved distally, 6–30 mm long, usually scabrous throughout, but at least basally. *Calyx* campanulate, 3–5(–6) mm long, the lobes 0.6–1.5 mm long. *Corolla* deep pink, 15–26 mm long, the throat glabrous across the base of the two flattened to slightly arched, forward projecting upper lobes, the upper two lobes 2–3 mm long and half the length of the three spreading lower lobes. *Anthers* 3–4 mm long, the upper filaments densely pubescent basally and distally. *Capsule* globose, 5–7 mm long. *Seeds* dark brown to nearly black, 0.8–1.6 mm long, $n=13$ (Vincent 1982). *Flowering* August–September.

Distribution.—Dry, sandy soils along roadsides, along the dry, sandy banks of the Arkansas River and the dry to xeric, sandy terrace communities just beyond the banks of the river. Very rare in the Ozark Highlands (Fig. 6), restricted to a few counties where the Ozark Highlands approach the Arkansas River Valley in Conway, Crawford, Franklin, and Pope counties in Arkansas, and Sequoyah County in Oklahoma. This is yet another species of *Agalinis* that reaches the limits of its range in the Ozark Highlands; in this case the species northernmost occurrence.

Ecology and conservation status.—G5; S1 in Arkansas, S1 in Oklahoma. This species was only recently found to occur in Arkansas, and most of the sites in the state are found outside of the Ozark Highlands along the Arkansas River. I believe based on my field work along the Arkansas River alone that enough sites will eventually be found to judge this species demonstratively secure in Arkansas. *Agalinis homalantha* has also been collected recently in Mississippi. While reviewing the holdings of *Agalinis* at the Missouri Botanical Garden in January 1997, I found a specimen originally determined as *A. tenuifolia* that is actually *A. homalantha*; this collec-

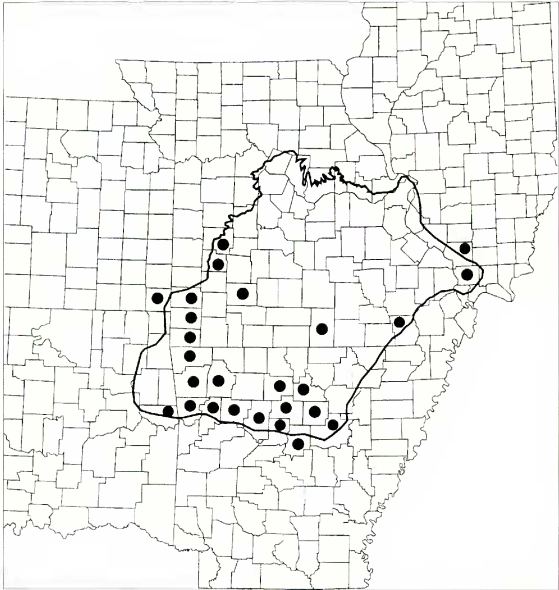


FIG. 3. Presently confirmed county records in the Ozark Highlands for *Agalinis fasciculata*.

tion represents the first known occurrence for this species in Mississippi. MISSISSIPPI: Bolivar Co.: 2 mi S of Rosedale, W of MS HW 1, T23N, R8W, S. 27, S2; coarse, sandy soil along wood's edge between levee and Mississippi River, 16 Aug 1990, Bryson 10170 (MO).

In our area this species is most easily confused with *A. tenuifolia*, from which it can be readily distinguished by its scabrous stems and pedicels, the two very short, flattened or slightly arched upper corolla lobes, the size of the anthers, which average twice as long as those of *A. tenuifolia*, and the much larger seeds.

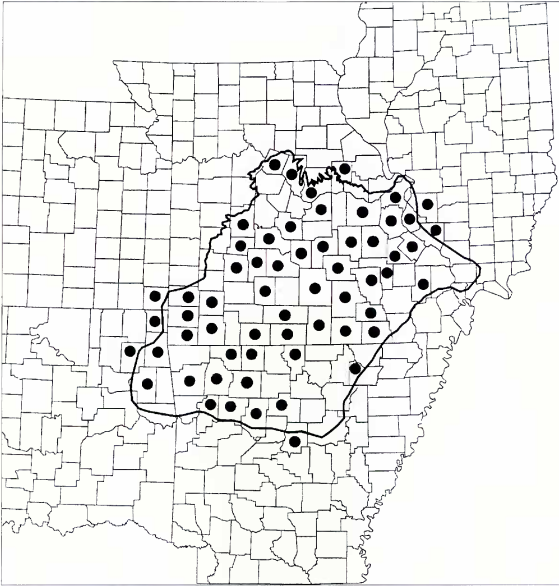


FIG. 4. Presently confirmed county records in the Ozark Highlands for *Agalinis gattereri*.

7. *Agalinis purpurea* (L.) Pennell. *Agalinis purpurea* (L.) Pennell var. *purpurea*. *Gerardia purpurea* L. var. *purpurea*. *Gerardia purpurea* L. f. *purpurea*.

Gerardia purpurea L. f. *albiflora* Britton.

Stem 1–10 dm, glabrous to subglabrous, much branched on larger plants. *Leaves* linear to narrowly linear-lanceolate, 1–4(–5) mm wide, 1–5 cm long, spreading, arching, or curling, scabrous above and often on the midveins below. *Fascicles* usually absent or only weakly developed, but when present clearly shorter than the main leaves. *Inflorescences* short to elongate racemes. *Pedicels* 2–5(–6) mm long. *Calyx* campanulate to hemispherical, 4–6 mm



FIG. 5. Presently confirmed county records in the Ozark Highlands for *Agalinis heterophylla*.

long, the lobes 0.8–2(–2.3) mm long, the five principal veins of the calyx (leading to the calyx lobes) glabrous or rarely a few veins slightly scabrous. *Corolla* rose-purple, rarely white, 18–33 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes. *Anthers* 2–3.5 mm long. *Capsule* subglobose, 4–6 mm long. *Seeds* dark brown to black, 0.7–1.2 mm long, $n=14$ (Canne 1981). *Flowering* late August–early October.

Distribution.—Moist prairies and roadsides, moist open ground, ditches, and pond margins. Rare and scattered in the Ozark Highlands (Fig. 7), but probably more common than its distribution suggests.

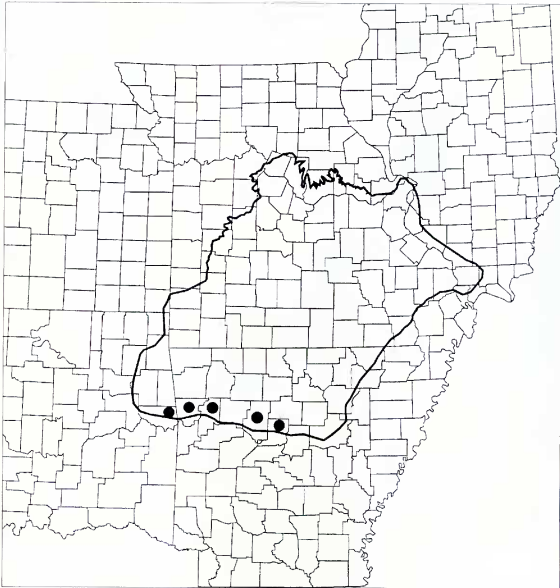


FIG. 6. Presently confirmed county records in the Ozark Highlands for *Agalinis homalantha*.

Ecology and conservation status.—G5; S2 in Kansas, S2 in Missouri. *Agalinis purpurea* and *A. fasciculata* are the most difficult species to distinguish from one another in the Ozark Highlands due to the variable nature of each taxon (see the discussion under *A. fasciculata*). Although *A. fasciculata* can be found under wet to mesic conditions, *A. purpurea* cannot tolerate the more xeric conditions favored by *A. fasciculata* in our area, and thus a difficult specimen collected on an upland prairie or another dry to xeric site can be defaulted to *A. fasciculata*. Occasionally, *A. purpurea* is found in dry soil, but close attention to its associate species will indicate that the habitat is actually a seasonally dry, moist to wet community.

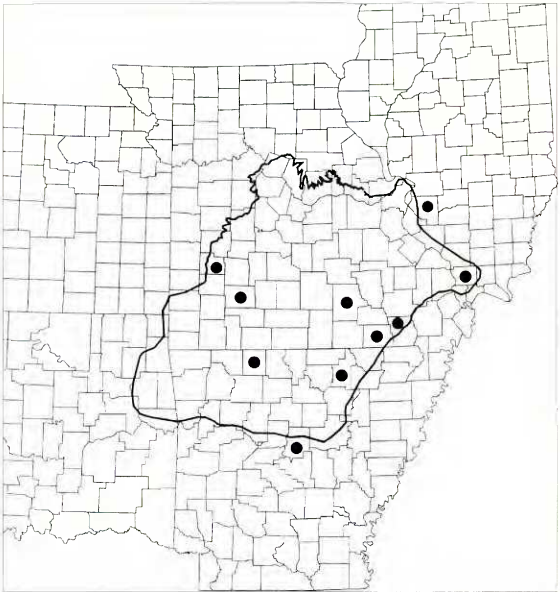


FIG. 7. Presently confirmed county records in the Ozark Highlands for *Agalinis purpurea*.

8. *Agalinis skinneriana* (A. W. Wood) Britton. *Gerardia skinneriana* A. W. Wood.

Stem 1–5(–6) dm, sharply 4-angled, appearing winged, the angles scabrous but the stem faces glabrous, simple to sparingly branched, the branches ascending. *Leaves* linear, ascending-appressed, the lowermost slightly spreading, 0.5–1.5 mm wide, 1–2(–2.5) cm long, scabrous above and on the midveins below. *Fascicles* absent. *Inflorescences* short racemes. *Pedicels* 0.4–1.6(–2) cm long. *Calyx* hemispherical, 2–4(–4.5) mm long, the lobes 0.4–1.2 mm long. *Corolla* pink to rarely white, 8–16 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes, the outside of the three lower lobes glabrous. *Anthers* 0.6–1.2 mm long. *Cap-*

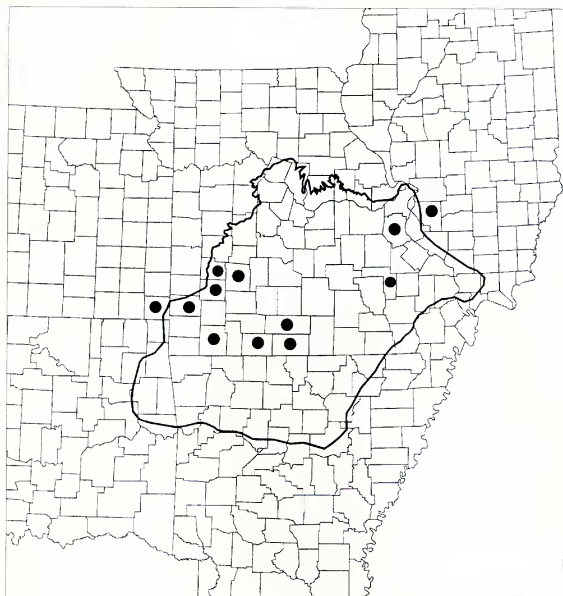


FIG. 8. Presently confirmed county records in the Ozark Highlands for *Agalinis skinneriana*.

sule globose, 3.5–5 mm long. *Seeds* 0.6–1.0 mm long, yellowish. $n=13$ (Canne 1984). *Flowering* late August–early October.

Distribution.—Dry prairies and large dolomite glades. Rare and localized in the Ozark Highlands (Fig. 8).

Ecology and conservation status.—G3; S2 in Illinois, S3 in Missouri. Although not state-listed in Kansas, there are only a handful of known sites there, and the species clearly warrants protection in that state. Smith (1988) reported *A. skinneriana* from numerous counties in Arkansas, but I have been able to locate only one historic (19th century) specimen of this species for the state in all of my herbarium searches, and the specimen has

very imprecise label data. ARKANSAS: Prairies and woods, N.W. Arkansas, *Floyd s.n.* (UARK); all other specimens seen by me labeled *A. skinneriana* have proved to be another species. The sites in Barry and Iron counties, Missouri, are based on historic collections, but I believe that *A. skinneriana* will eventually be relocated in Iron County or found in adjacent Reynolds County, due to the abundance of suitable habitat (in this case igneous glades) that still remains in both counties. Steyermark (1963) also recorded *A. skinneriana* from McDonald County, Missouri. He was undoubtedly referring to a specimen collected by B.F. Bush, cited by Pennell (1929), that resides in the herbarium of the Botanical Museum at the University of Copenhagen, Denmark (C). But because I did not review this specimen I have not included *A. skinneriana* from McDonald County, although Pennell's annotation was in all likelihood correct.

On dry prairies *A. skinneriana* occurs mostly where the vegetation is sparse, such as the summit of hills or on gentle slopes where the substrate is near the surface, or along the upper parts of the narrow draws that frequently occur on prairies, where some slight erosion is usually evident. On dolomite glades it is found in either the more vegetated parts of the glade or in nearly bare soil.

In the Ozark Highlands *Agalinis skinneriana* is often confused with *A. gattereri*, or smaller plants of *A. tenuifolia*. It is readily distinguished from *A. tenuifolia* by the corolla, which in *A. skinneriana* is pubescent within across the base of the two reflexed-spreading, upper corolla lobes, and by the sharply winged stem with its noticeably scabrous margins. It can be distinguished from *A. gattereri* by the presence of a true raceme, the glabrous outersurface of the three lower corolla lobes, and erect-ascending leaves.

9. *Agalinis tenuifolia* (Vahl) Raf. *Gerardia tenuifolia* Vahl. *Gerardia tenuifolia* Vahl var. *tenuifolia*, *Gerardia tenuifolia* Vahl subsp. *tenuifolia*.

Agalinis besseyana (Britton) Britton.

Agalinis tenuifolia (Vahl) Raf. var. *macrophylla* (Benth.) S.F. Blake. *Gerardia tenuifolia*

Vahl var. *macrophylla* Benth. *Gerardia tenuifolia* Vahl subsp. *macrophylla* (Benth.) Pennell.

Agalinis tenuifolia (Vahl) Raf. var. *parviflora* (Nutt.) Pennell. *Gerardia tenuifolia* Vahl

var. *parviflora* Nutt. *Gerardia tenuifolia* Vahl subsp. *parviflora* (Nutt.) Pennell.

Stem 2–7 dm, subglabrous to glabrous, much branched on larger plants. *Leaves* linear to lanceolate, spreading, ascending, or arched, 1–5(–6) mm wide, 3–7 cm long, scabridulous above and often on the midveins below. *Fascicles* absent or present. *Inflorescences* elongate racemes. *Pedicels* slender, spreading, often abruptly upcurved distally, 6–25 mm long. *Calyx* hemispherical, 3–5.5 mm long, the lobes 0.5–2 mm long. *Corolla* light to dark pink, 10–16 mm long, the lobes 4–6 mm long, the throat glabrous within across the base of the two forward arching, upper lobes, the two upper lobes subequal to the three lower lobes. *Anthers* 1–2(–2.3) mm long. *Capsule* globose,

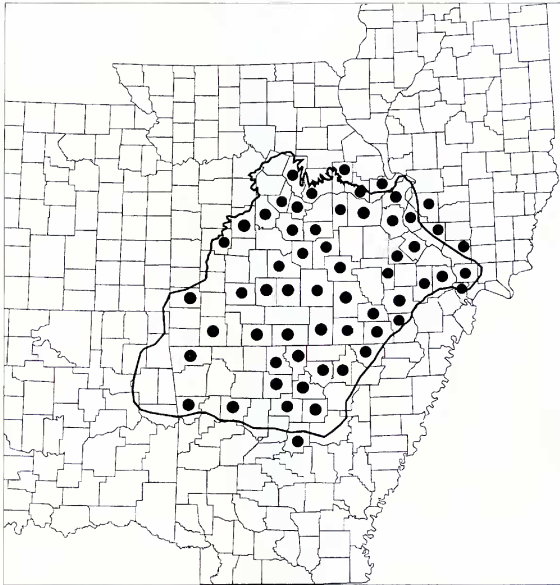


FIG. 9. Presently confirmed county records in the Ozark Highlands for *Agalinis tenuifolia*.

4–6 mm long. *Seeds* tan to dark brown, 0.7–1 mm long. $n=14$ (Canne 1984). *Flowering* principally from late August–early October, occasionally flowering as early as late June.

Distribution.—Dry or moist prairies, borders of woodlands, ponds, marshes, and rocky streams, also in ditches, fallow fields, and along railroads and roadsides. Common in the Ozark Highlands (Fig. 9), but less frequent in the west and southwest portions of the region.

Ecology and conservation status.—G5; S3 in Oklahoma. Along with *Agalinis gattingeri*, *A. tenuifolia* is the most common species in the Ozark Highlands, and is the most common and widespread species of *Agalinis* in North

America. *Agalinis tenuifolia* and *A. gattingeri* are the only two species that occur with any frequency in the Ozark Highlands, the other species being restricted to the periphery of our area or to particular habitats within the Highlands. *Agalinis tenuifolia* is easily recognized in the field during flowering by the two long, forward arching, upper lobes of the corolla, which project over the anthers and most of the style. The only species that it can be confused with in the field during flowering in our area is *A. homalantha*. In *A. homalantha*, however, the style extends well beyond the two very short, forward to slightly arching upper corolla lobes, the pedicels are scabrous, and the species has a specific habitat and restricted range in our area.

Agalinis tenuifolia is a complex and variable species for which a number of intergrading varieties have been described. As Steyermark (1963) aptly stated of the varieties in our area: "The varieties presented here are not very distinct, except in their extremes, often showing overlapping characters, thus making their determination doubtful or unsatisfactory." Although it is possible at times to identify plants confidently as a particular variety, I believe it best at present to treat these weak varieties as one highly variable species pending future research.

10. *Agalinis viridis* (Small) Pennell *Gerardia viridis* Small.

Stem 1–6 dm, sharply 4-angled, appearing winged, the angles and stem faces glabrous, with a few to many widely spreading branches. *Leaves* linear 0.5–2 mm wide, sometimes the lowermost stem leaves approaching 3 mm in width, 1–2.5(–3) cm long, scabrous above and on the midveins below. *Fascicles* absent. *Inflorescences* racemes. *Calyx* campanulate, 3–4.5 mm long, the longest lobes 1.5–2.2 mm long. *Corolla* translucent to pink, 8–12 mm long, the throat noticeably pubescent within across the base of the two reflexed-spreading, upper lobes, the outside of the three lower lobes glabrous. *Anthers* 0.8–1.3 mm long. *Capsule* obovoid, 5–6(–7) mm long. *Seeds* yellowish, 0.7–1 mm long, $n=?$. *Flowering* late August–September.

Distribution.—Moist prairies, along the non-forested portions of prairie draws, along the borders of seasonally wet depressions in prairies where the vegetation is sparse, and rarely on the drier portions of prairies. Very rare in the Ozark Highlands (Fig. 10), where it is currently known from only four counties.

Ecology and conservation status.—G4; S1 in Missouri, S1 in Oklahoma. *Agalinis viridis* is yet another species that reaches its northern and northwesternmost occurrence in the Ozark Highlands; it is much more common south of the Arkansas River, and occupies a wider range of habitats there. The Jasper County, Missouri, location represents an isolated occurrence of this species; it was once collected throughout this county, but is now re-

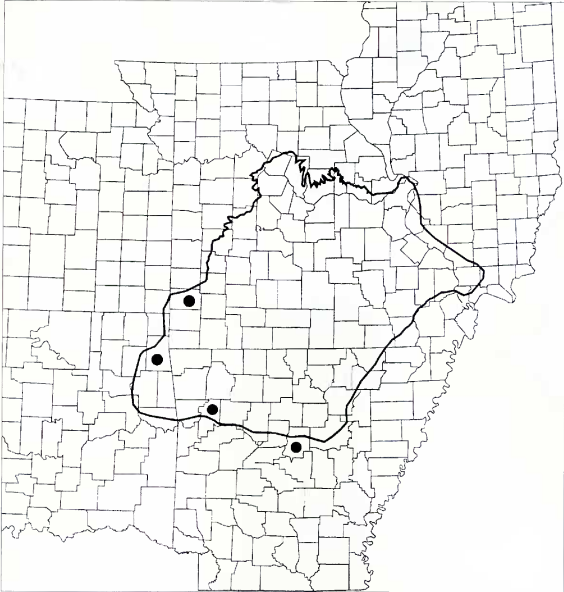


FIG. 10. Presently confirmed county records in the Ozark Highlands for *Agalinis viridis*.

stricted to Wah-Sha-She Prairie Natural Area, over 300 kilometers from the nearest known extant site for this species.

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